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CERVALCES AMERICANUS, A FOSSIL MOOSE, OR ELK, FROM THE  
QUATERNARY OF NEW JERSEY.

BY W. B. SCOTT.

Several species of Elk or Moose have been found in the Quaternary deposits of the United States, and have been described by various observers. For the most part, however, the remains described have been so imperfect as to be of little value from a morphological point of view. The earliest account we have of such fossils is to be found in the Proceedings of the American Philosophical Society for 1818, p. 375. This is "an account of two heads found in the morass called the Big-Bone Lick, and presented to the Society by Mr. Jefferson," and was written by Dr. Caspar Wistar. One of these heads is assigned by Dr. Wistar to *Cervus*, and is thus described: "If it belonged to the genus *Cervus*, it was one of the largest species of that genus.

"The comparison of figures 4 and 5 with figures 6 and 7 (skull of wapiti), shows that the lately discovered skull resembles that of the Round-Horned Elk at the occiput, although it differs from it greatly in the position and projection of the horns. There is also in the Round-Horned Elk a considerable prominence of the frontal bone between the bases of the horns, which does not appear to have been the case in the newly-discovered head. [In part, at least, this is due to abrasion of the specimen.—S.] The bones of this last-mentioned head have a concavity or depression on the under surface near the root, which is not the case in the Round-Horned Elk.

"The cranium of the Moose, or *Cervus alces*, is very different. The occipital portion is concave exteriorly, and the superior margin has an angular indentation in it. There is a remarkable prominence between the horns, which extends considerably towards the nose. The horns of it project laterally like those of the newly-discovered head, and they have a concavity on the under surface near the root." . . . "I believe that each of the last-mentioned heads (*i. e.*, wapiti and moose), is at least of the ordinary size, as their horns are large, and it appears, from a comparison of the respective measurements, that the head lately discovered is larger than either of them."

Wistar did not name the species here described ; this was done in 1825 by Harlan, in his *Fauna Americana*, who called it *Cervus americanus*. The only addition of importance to our knowledge of this species we owe to Dr. Leidy, who, in his "Ancient Mammalian Fauna of Dakota and Nebraska," p. 379, describes a pair of metacarpals accompanying the head described by Wistar, which Leidy says indicate an animal of greater stature, but more graceful proportions, than the great Irish Deer.

When Harlan named the species, the genera *Cervus* and *Alces* had not been separated ; their later separation gave rise to a great confusion of nomenclature. In 1835 Sir William Jardine (*Naturalists' Library*, vol. xxi, p. 125), elevated *Alces* into a distinct genus, and called the American species *A. americanus*. Jardine supposed that Harlan's species was a true *Cervus*, and refers to it as the "fossil cranium and horns of a stag, . . . to which Dr. Harlan has applied the name of *C. americanus*," (p. 162). In 1836 Ogilby named the European elk *Alces machlis* (*P. Z. S.*, 1836, p. 135), the name now generally employed for both varieties, while Harlan's name for the species described by Wistar has never been disturbed or questioned. But judging from Wistar's specimen, it becomes at once evident that this species is altogether different from *Cervus*, and belongs either to *Alces* or some closely allied genus. If it is to be classed in *Alces*, its specific name must be *A. americanus*, which name has been used by Jardine for the American moose. It will thus be seen that a serious confusion of names has arisen.

No other American fossil moose has received a special name, though many specimens have been found, some of the finest of which were in the Museum of the Chicago Academy of Sciences, and were destroyed in the great fire of 1871.<sup>1</sup>

Through the kindness of the Rev. A. A. Haines, the Museum at Princeton has received an almost complete skeleton of a very large extinct species of elk or moose, which was discovered in a shell-marl deposit under a bog at Mt. Hermon, New Jersey, six miles from Delaware Station on the Delaware, Lackawanna and Western Railroad. This superb specimen is practically complete, the only missing bones being five caudal vertebræ ; two ribs ; the right scapula and humerus ; the right unciform and pisiform, and

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<sup>1</sup> See Judge Caton's *Antelope and Deer of America*, p. 194.

the trapezium of each side; one anterior ungual phalanx; the left calcaneum, and a number of bones of the rudimentary lateral digits. With the exception of the caudal vertebræ every missing bone of importance is represented by its fellow of the opposite side, so that it was well nigh impossible to go astray in making the necessary restorations.

The skeleton was of an adult, but not old, individual, as is shown by the condition of the epiphysis and teeth. The missing parts have been restored, and the entire specimen most skilfully mounted by Curator F. C. Hill. (See Pl. II).

A careful comparison of the Princeton specimen with that described by Wistar, which, together with the metacarpals described by Leidy, is preserved in the Academy of Natural Sciences of Philadelphia, convinces me that in all probability the two specimens belong to the same species. There are some unimportant differences and the old specimen is too imperfect to put this identification beyond question. But what remains of the Philadelphia skull agrees almost perfectly with the Princeton one, and at present there can be no reason for assigning them to different species.

On examination, however, it becomes evident that the species in question cannot be included in any known genus, as these are at present defined. While its affinities are undoubtedly closest to *Alces*, yet if we include it in that genus, the generic definition must be altogether remodeled and some of its most prominent characteristics would have to be suppressed. The differences from all known species which this fossil form shows, are of sufficient importance to entitle it to rank as a separate genus. With considerable reluctance, therefore, and in view of the confused nomenclature of the species, I feel compelled to form a new name for the genus. I would propose the name *Cervalces*, as indicating the types which it seems to connect. The genus may be defined as follows: *Cervalces*. Antlers dichotomous and palmated, though much less so than in *Alces*; beams horizontally directed, as in that genus, but with much longer pedicels; bez-antler and posterior tine present as in *Dama*, but these are connected by a broad and flaring process of bone, which descends below the level of the eyes. This does not occur in any other member of the *Cervidæ*. Nasals much longer than in *Alces*, a little shorter than

in *Cervus*; anterior nares very much smaller than in the former, but larger than in the latter; premaxillæ shaped as in *Cervus* and reaching the nasals. Head broader than in *Alces*, prominence on frontal ridge and supra-occipital indentation absent. Upper and lower molars with supplementary columns; no upper canines. Ante-orbital vacuity bounded above by a separate bone (prefrontal?). Neck and trunk short, legs exceedingly long. Distal ends of lateral metacarpals present; internal cuneiform fused with the metatarsal.

As Harlan's name must undoubtedly be retained this species will be known as *Cervalces americanus*.

In the skeleton of this curious and striking fossil, the most obvious peculiarity is the great length of the legs, which gives the animal a remarkably stilted appearance, while the thorax is shallow, and the neck short. The shoulders are higher than the hips, as in the moose, and unlike the stag. The combined length of the head and neck shows that in the ordinary position of the legs, the muzzle would not reach the ground by 14 or 15 inches. Measured in the same manner the moose's muzzle reaches within about 10 inches from the ground, and that of *Megaceros* 8 or 9. These facts are of importance with reference to the question of the animal's habits and the presence of a prehensile upper lip.

Turning now to the characteristics of the skeleton in detail, we begin with :

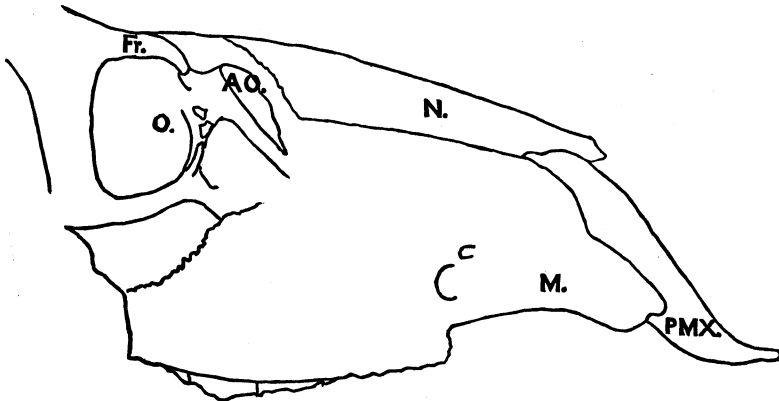
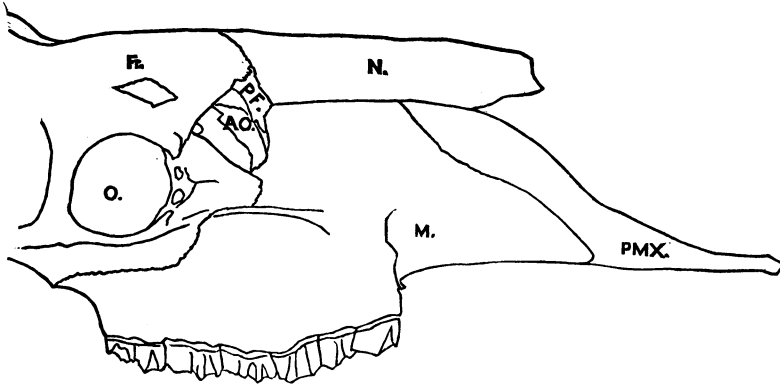
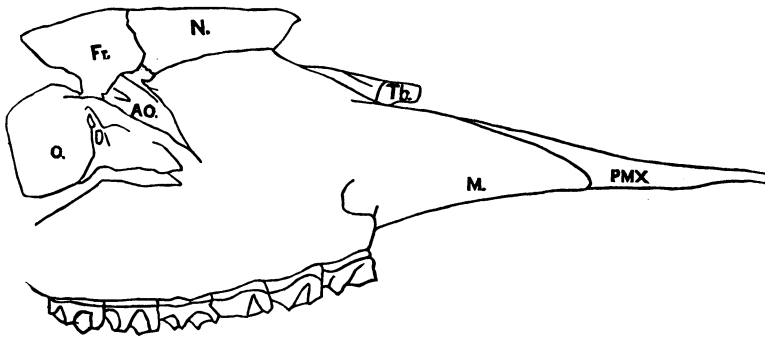


FIG. 1. Side view of face of *Cervus Canadensis*.

FIG. 2. Side view of face of *Cervulus Americanus*.FIG. 3. Side view of face of *Alces machilis*.

### THE SKULL.

The skull resembles most that of the living moose, though strikingly different from it in many respects, in which it approximates to *Cervus*. In spite of the greater size of the animal, the skull is both absolutely and relatively shorter than in the moose; this reduction, however, is chiefly confined to the region in front of the molar teeth. The cranium is considerably broader than in *Alces*, especially between the bases of the antlers. The appearance of that part of the face which is in advance of the molar teeth is strikingly different from the same region in the moose, and approximates rather that of *Cervus* (see figs. 1, 2 and 3). This difference is further increased by the fact that the nasals

of the fossil are more than twice as long as in the moose; this increase of length of the nasals, together with the shortening of the face renders the appearance of the anterior nares very different from those of the moose. The edge of the nares in the latter measures nearly 11 inches, in the fossil hardly 8; in a large skull of *Cervus canadensis* the measurement is  $4\frac{1}{2}$  inches.

The *Premaxillæ* are like those of *Cervus* and not at all like those of *Alces*; they lie external to the anterior ends of the maxillæ and reach up to the nasals with which they articulate by a surface nearly an inch in length, while in the moose the ascending ramus of the premaxilla is inserted into a groove in the front edge of the maxilla and does not reach the nasals by several inches. This is not due merely to a shortening of the nasals, for though the ascending ramus is very long, its direction is so oblique that it does not rise to the level of the nasal, and no prolongation of the latter would effect a junction. The shape of the premaxilla is also very different in the two species, the horizontal portion being shorter, the ascending portion longer, and the posterior angle between the two sharper in the fossil than in the recent form. In all these respects the former shows an approximation to the shape of the bone in *Cervus*. Seen from the side the edge of the nasal opening is very different from that of the moose. In the latter this edge is very long and directed obliquely downwards and forwards (see fig. 1), while in the former the descent is much more abrupt. The whole tube inclosing the nasal cavity is much longer than in the moose, in which animal the turbinal bones project beyond the edge of the premaxillæ (fig. 3), and so can be seen from the side, while in the fossil they do not quite reach the edge of the nares (fig. 2).

The *Maxillæ* are more like the corresponding bones of *Cervus* than those of the moose. The difference, however, is almost altogether in the anterior part. The front edge is much less oblique and takes no part in the formation of the anterior nares. The edentulous part of the bone in advance of the molars is much shorter than in the moose, but the upper facial portion is of about the same length. As in *Alces*, the palatine plates in front of the molar teeth are contracted much more than in *Cervus*. There is a further difference from either of the genera in the fact that the alveolus behind the last molar is very narrow and short,

ending in a mere hook. The condition is not unlike that seen in *Megaceros*.

The *Nasals* are intermediate in size and shape between those of *Cervus* and *Alces*. In *C. canadensis* these bones are about  $\frac{2}{5}$  the entire length of the skull, in the moose a little less than  $\frac{1}{6}$ , in *Cervalces*  $\frac{1}{3}$ . In length, in their narrower and emarginate free ends, the nasals are like those of the true deer, but resemble those of the moose in not being so flat, but having the upper and lateral parts meeting at nearly a right-angle. The nasals in the fossil are in contact throughout their entire length, not having their posterior ends separated by the wedge-shaped process of the frontals, as is the case in the moose. These posterior ends are sharper and less abruptly truncated than in the latter animal.

The length of the nasals and shape of the anterior nares in *Cervalces* show that if the animal possessed a proboscis-like snout at all, it could not have been anything like as prominent and well developed as in the moose; such a proboscis being always accompanied by a great shortening of the nasals, as in the elephant, tapir, moose, *Sivatherium*, etc.

The *Frontals* present us with another difference from the moose and resemblance to the deer. As in both genera, there is an abrupt depression of the forehead in front of the antlers, but this is less than in *Alces*. In the latter there is a sharp knob on the ridge connecting the pedicels of the antlers, but in the fossil this knob is but faintly indicated. The forehead is broader and the orbits more projecting than in the moose, in both respects showing approximations to the cervine type.

The *Lachrymal* is of the ordinary size and shape, but the pit is unusually shallow. The ante-orbital vacuity is more quadrate in shape than is the case in *Alces*. The upper edge of this vacuity is bounded by a small distinct bone which I have not been able to find in any other of the *Cervidæ*, though what looks like a rudiment of it is attached to the nasal in the moose. The bone in question articulates with the nasal, frontal and maxillary; thus in position corresponding to the prefrontal, though morphologically it may be a separated portion of the nasal. It is hardly probable that this is a mere sport, as the bone is present on both sides, and is certainly a great peculiarity. (Fig. 2, P. F.)

The *Jugal* has more the shape of that in *Cervus* than that of



the moose, in the simpler maxillary suture and shorter anterior process. The orbit is somewhat smaller than in the moose, and more nearly circular, the vertical diameter being greater in the latter, while the antero-posterior diameter is about the same in both. While the frontal rim of the orbit is more projecting than in *Alces* and the whole orbit is deeper, the jugal rim is less distinctly marked off from the body of the bone.

The *Squamosal*, with its zygomatic process, is almost exactly like that of the moose, the zygoma being directed downwards and forwards, instead of being almost horizontal as in the other *Cervidæ*. This peculiar shape of the zygoma is due to the great depression of the forehead, which, though somewhat less than in the moose, is greater than in the deer. If the plane of the upper molar alveolus be produced backwards, it will be found that the distance from the summit of the sagittal crest to this plane is much greater than in *Megaceros* (*Cervalces* 9 in., *Megaceros* not quite 6).

The *Occiput*. As Wistar pointed out, the occiput of the fossil is rather deer-like, in lacking the indentation of the supra-occipital, and in the greater flatness of the entire occiput. As in the moose, however, the condyles are nearly in contact below, while in *Cervus* they are quite widely separated. The basi-occipital has two large rugosities just in advance of the condyles, as in *Alces* and *Megaceros*. The paroccipital processes are stout and of the same shape as in the moose, though somewhat shorter. The proportions of the exposed part of the periotic are about as in that animal. The same is true of the tympanic which does not form an inflated auditory bulla.

The structures at the base of the skull—sphenoids, pterygoids, palatines, vomer and turbinals—need no special description, being very much as in the moose.

The *Inferior Maxillary* resembles the corresponding bone in the moose more than that of the other *Cervidæ*, but with some differences. The jaw, as a whole, is somewhat shorter and broader, the diastema and symphysis slightly shorter, and the coronoid process shorter and heavier.

The *Dentition* is like that of the moose, though with some cervine features. The crowns of the upper molars are shorter than in *Cervus*, but as in some species of that genus they have

well-marked internal supplementary columns; all the lower molars have distinct external columns. In some specimens of the moose there is a small column on the first molar, a slight indication of one on the second, and none on the third; in others the second and third have small rudimentary columns. This may, perhaps, indicate that in this species the columns are in process of disappearance, having vanished in the upper jaw from all but the first molar. According to Owen, these columns are present in the upper molars of *Alces* (Brit. Foss. Mam., p. 450). This may be true of the Swedish elk, but not of the American specimens I have been able to examine. These supplementary columns do not appear to be constant generic characters, perhaps not even specific, though this latter is doubtful.

The stylo-hyals are present in the specimen, but are not especially peculiar.

*The Antlers.* The most striking peculiarities of *Cervalces* are to be found in the antlers, which are different from those of any of the *Cervidæ*, recent or fossil, with which I have been able to compare it, or of which I have seen any figure or description.

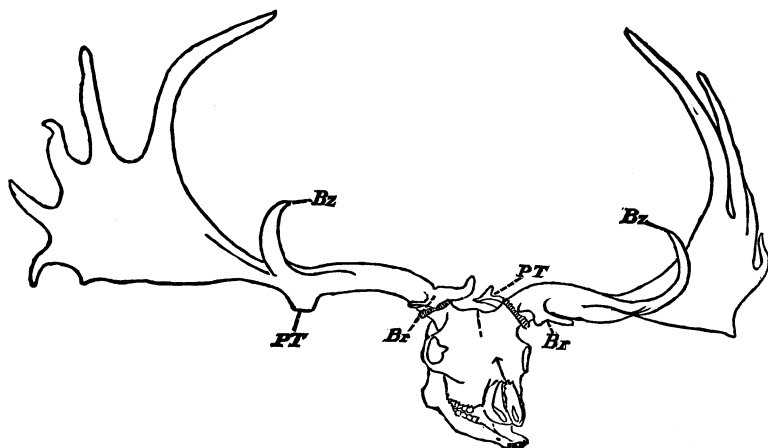


FIG. 4. Skull and antlers of *Megaceros hibernicus*.

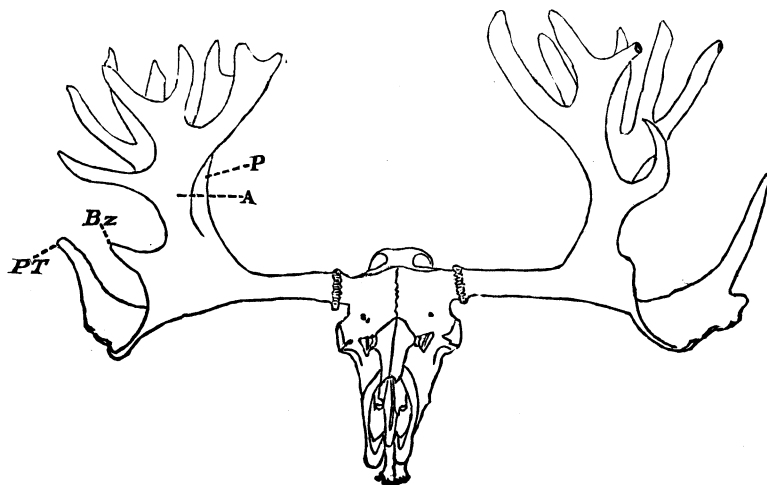


FIG. 5. Skull and antlers of *Cervalces Americanus*.

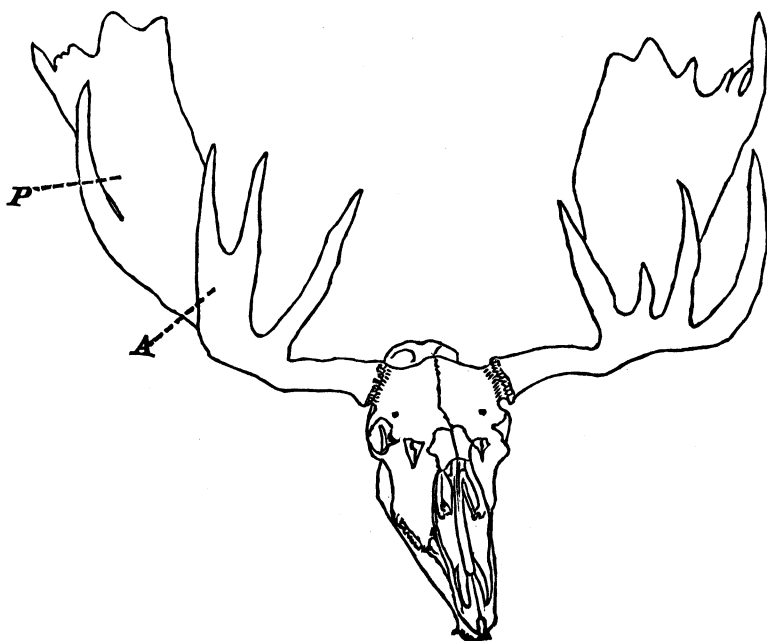


FIG. 6. Skull and antlers of *Alces machilis*.

The pedicels have an altogether horizontal direction, are somewhat longer than in the moose, and show a deeper posterior constriction, to allow the unobstructed movement of the coronoid process. The burrs are quite widely separated, almost an inch more than in the specimen described by Dr. Wistar. The beam is directed horizontally outwards, as in *Alces*, even drooping a little, as noticed by Leidy, and is unusually long before reaching the point of branching. Leaving out of account for the present the peculiar portion of the antler, it obviously belongs to the palmated dichotomous type of *Alces*. The ordinarily accepted view with regard to the antlers of that animal is that brow-antlers are not present. Sir Victor Brooke, however, considers the anterior division of the antler the homologue of the brow-branch (P. Z. S., 1878, p. 915). Assuming the correctness of the ordinary view, the fossil form agrees with the recent in being devoid of the brow-branch. The main antler is divided into two palmated portions, of which the anterior is the smaller, though it is both proportionally and absolutely much larger than in the moose (figs. 5 and 6, *A*). This portion is twisted on itself so that its flat side is presented forwards in a plane almost at right-angles to that of the posterior division. The palmation of this anterior portion is somewhat more pronounced, and the tines more flattened than in the moose. In the figures all the tines appear somewhat blunt, though this is due to the fact that the animal died while the antlers were yet in "the velvet." In the moose the division into the two palms takes place in a plane only a little above the level of the frontal ridge ( $2\frac{1}{4}$  in.), in the fossil the beam turns sharply upwards for several inches ( $6\frac{1}{2}$ ) before the point of separation is reached. The appearance of the anterior branch is very different from what is seen in the moose. In the specimen before us there arises from the point of division a narrow flat plate somewhat twisted on itself, which gives off a sharp and stout lateral tine, two or three inches above the point of division; above this tine the plate broadens for a little distance and then bifurcates. On the right side both of these divisions are again bifurcated, the outer one much more deeply than the inner; on the left side the inner prong does not divide, though it is broad and flat. This gives five prongs on the right side and four on the left. Except the lateral tine, all the tines are flattened antero-posteriorly, having a plate-like appearance from the front.

In the moose, on the other hand, the anterior division shows a broad basal palm, which sends up a number of long, sharp and rounded tines, all arising at about the same level (fig. 6, *A*), though adjacent ones may be more or less connected by palmaria.

The posterior division of the antler also differs markedly from that of the moose in being much smaller and much less palmated. The size of the palm in its greatest diameter being 9 by 8 inches, while in one specimen of the American moose at Princeton these dimensions are 28 by 17 inches. In the latter animal the tines of this division of the antler are, with the exception of the first mere finger-like processes from the top of the palm (fig. 6). In *Cervalces*, as in the European elk, and some specimens of the American moose, the tines are very much longer, though the palm in the European variety is still much greater than in the fossil. Owing to the height at which division into the anterior and posterior branches of the antlers takes place in *Cervalces*, the first tine of the hinder branch is very much shorter than in the moose (*Cervalces*  $13\frac{1}{2}$  inches, *Alces* 21 inches).

The proportionate number of tines in the two divisions is also different in the living and extinct species. In one American moose I find the numbers to be: right antler, anterior 3, posterior 8; left, ant. 4, post. 8. Another specimen gives: ant. 2, post. 5; in a third specimen, ant. 4, post. 8. A European specimen gives ant. 4, post. 7; another is ant. 3, post. 6. In the fossil, on the other hand, we have on the right side, ant. 5, post. 5; left side, ant. 4, post. 4; showing a different method of growth in *Cervalces* from that observed in any known species of *Alces*.

The feature, however, which differentiates the antler of *Cervalces* from that of all other known *Cervidæ* remains to be described. Where the upper edge of the beam rises to form the palmated portion of the antlers, the lower edge expands into an immense concave process, which is presented outwards like the mouth of a trumpet, and which ends both anteriorly and posteriorly in a round, pointed tine, the latter being long, the former quite short (fig. 5, *P.T.* and *Bz.*). The posterior tine is directed obliquely outwards and backwards, so that the distance between those of the two antlers exceeds five feet. On the left side there is a rudimentary tine or snag at the base of the long posterior tine, on the right

side the broad plate of bone gradually tapers off into the tine. It is a curious fact that these great ear-like processes descend considerably below the level of the eyes, so that the animal's vision in a lateral direction must have been seriously interfered with. It is difficult to understand how any such structure of the antlers could have arisen or what its purpose was.

On comparing the antlers of the extinct species with those of

the moose, it becomes evident that the former consist of the same parts as those of the latter, with something added to them. Just what these additional parts are is by no means easy to say. The anterior tine (of the ear-shaped process) may be the bez-antler, while the posterior one may correspond to the tine which in *Megaceros* (figs. 4 and 4 a, *P. T.*), the fallow deer (see Brooke, *P. Z. S.*, 1878, p. 914, fig. 9), and some others, is given off from the hinder surface of the beam nearly opposite the bez-antler

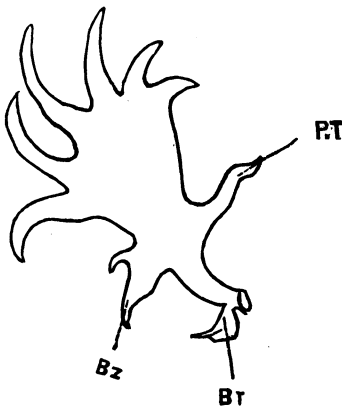


FIG. 4a.

Right antler of *Megaceros hibernicus*, from the inside.

(*d* in Brooke's system). If in *Megaceros* the palmated portion of the antler were bent sharply upwards nearly at right-angles with the beam, the posterior tine directed more outwards and connected by a broad and flaring plate of bone with the bez-antler in front, the resulting condition would be very much what we find in *Cervalces*. If this conjecture as to the homologies of these tines be correct, Sir Victor Brooke's views on the parts of the moose's antler can hardly be accepted (*P. Z. S.*, 1878, p. 915). It is worthy of notice that in *Cervalces* almost all the weight of the antlers is in advance of the occiput. To a much smaller extent this is true of the moose, while in most of the *Cervidæ* the weight is entirely back of the occiput.

It might be suspected (as for a time I did suspect) that in this fossil we have to do with a case of monstrosity rather than with a true species character—some such phenomenon as the double-

palmed moose antlers from Sweden, and those found fossil in America, as illustrated by Judge Caton,<sup>1</sup> or as in the case of the curiously palmated antlers from Texas, reported by the same observer (*American Naturalist*, vol. xviii, p. 736). While of course this may possibly be the case, it seems very improbable for the following reasons: (1) The symmetry of the antlers, which show no sign of injury or distortion, and which are precisely alike on both sides, except that on one side two tines are bifid, which on the other are single. But such inequality is very common on all large antlers; in fact, is rather the rule than the exception. The double-palmed antlers of which Judge Caton speaks are so only one side. (2) Monstrosities, except in cases of atavism or in mere *repetition* of parts normally present, are much more apt to be in the direction of simplification than of increased complexity. It is therefore very unlikely that these antlers are simply sports from the ordinary *Alces* type, for they contain elements which are never found in the moose, but which seem rather to belong to the true deer.

Gray's view that *Cariacus* lacks the brow-antler can hardly be correct, as the so-called "basal-snag" of that genus is clearly nothing else. Prof. Cope's statement<sup>2</sup> that palmation of the antlers transfers a form from *Cariacus* to *Alces*, is one that I cannot accept. Of the many differences which separate the two genera, the palmation of the antlers is the least important. Any such transfer must ignore the much more significant features of the teeth, skull, and limbs.

#### SKELETON OF THE TRUNK.

*Cervical Vertebrae.* The neck is short when compared with the height of the animal, shorter even than in the moose. The atlas is provided with a large and heavy hypapophysis, of which only a small rudiment is to be seen in the moose or in *Megaceros*, but is quite well developed in *Cervus elaphus*. Richardson, however, figures a moose's atlas from Canada, in which the hypapophysis is very distinct (*Zoology, Voyage of Herald*, pl. xxi and xxii). The remaining cervicals show only differences of detail from those of *Alces*; thus the transverse process of the axis is more slender,

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<sup>1</sup> Antelope and Deer of America, p. 194.

<sup>2</sup> American Naturalist, vol. xviii, p. 738.

the pleurapophysial plate on the sixth vertebræ is smaller, that on the fifth larger.

The only other member of the *Cervidæ* with which *Cervalces* can be compared in size, is the great extinct Irish deer *Megaceros*. But in the latter we find a very much longer neck, the vertebræ of which are vastly heavier, and all the processes are larger and stouter, showing the great muscular power necessary to wield the immense antlers. In *Cervalces* the cervical vertebræ appear puny in comparison.

*Trunk Vertebræ.* In *Megaceros* these vertebræ are provided with very long and heavy spines; those of the anterior thoracic being twelve or thirteen inches in length, on the posterior about eight. In *Cervalces* the spines are shorter and especially lighter. The rise of the back at the withers is even less marked than in the moose. The vertebral centra are also shorter and lighter than in *Megaceros*, giving a much shorter trunk. The lumbar, sacral and caudal vertebræ do not differ in any important way from those of the moose, except that the neural spines of the sacrum are somewhat more closely co-ossified.

The *Ribs* are rather short, only a very little longer than in the moose, and therefore proportionately considerably shorter. The thorax is consequently shallow, and together with the long limbs gives the animal a stilted appearance. The greatest depth of thorax from tip of neural spine to the sternum is in *Megaceros* 34 inches, in *Cervalces* 29, in the moose 28.

The *Sternum*, curiously enough, is somewhat different from that of the moose; the manubrium being smaller and of a somewhat different shape. The first two segments of the mesosternum resemble the corresponding parts in *Cervus*, and differ from those of *Alces* in being long and narrow, instead of short and broad.

#### THE LIMBS.

The limbs are remarkable for their great length and slenderness. Though considerably longer than those of the great Irish deer,<sup>1</sup> they are not nearly so stout. The hind legs are especially long, but the withers are higher than the rump, as is the case

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<sup>1</sup> It is very unfortunate that the name "Irish Elk" is so commonly applied to this animal, which seems rather to have been a gigantic fallow-deer.



with the moose. The *Scapula* is rather small in proportion to the size of the animal, being a little shorter than in the moose, and much more so than in *Megaceros*. In shape the bone is more cervine than alpine; the anterior border is straighter, and the prescapular fossa smaller than in the moose, while the neck is less contracted and the coracoid larger.

The *Humerus* is not different in any important way from that of the moose, except for a slight increase in length.

The *Ulna* and *Radius* show a still greater increase in length, but are only slightly thicker than in the moose, so in proportion they are more slender. As in *Alces*, the two bones are co-ossified only at the distal end, instead of being firmly united for two-thirds their length as in most deer.

The *Carpus* is like that of the moose in almost every particular, consisting of scaphoid, lunar, cuneiform, pisiform, trapezium, trapezo-magnum, and unciform.

The *Metacarpus* is very long, much of the great height of the animal being due to it. It is about one-half an inch shorter than in the largest of the two Philadelphia specimens, but the proportions are almost identical. The rudimentary lateral metacarpals are like those of the moose in shape, but are longer.

The *Phalanges* of the median digits are unusually long and slender, even when compared with those of the moose. The unguals are very long and pointed. The phalanges of the rudimentary digits are larger and heavier than in the moose.

The *Pelvis* is almost precisely like that of the moose, and needs no particular description.

The *Femur* is slightly longer, but no heavier than in the moose, and offers a striking contrast to the massive thigh-bone of *Megaceros*, which is as heavy as that of an ox. The trochlear groove is shallow, with sharp edges, and the patella is small. The great trochanter is higher than in the *Megaceros*, and rises more vertically from the shaft, but all the other processes for muscular attachment are much less prominent.

The *Tibia* is an exceedingly long bone, but its increase in length has not been accompanied by any corresponding increase in thickness. The astragalar groove is like that of *Alces*, the fibular facet and the fibula are like those of *Cervus*.

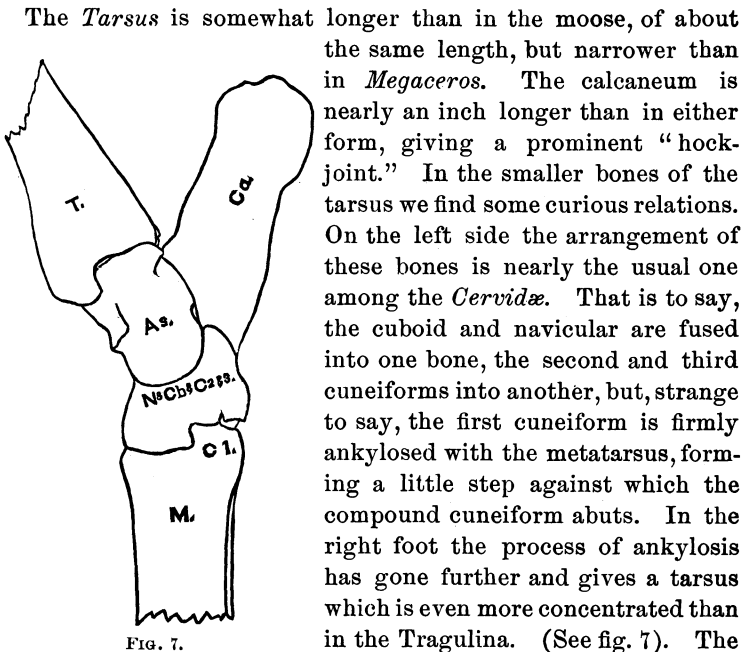


FIG. 7.

Right Tarsus of *Cervulus Americanus*. compound cuneiform is fused with the cubo-navicular (fig. 7, *N.* and *Cb.* and *C.* 2 and 3), and the first cuneiform, as in the left foot, with the metatarsus (fig. 7, *C* 3). This fusion of tarsal bones with the metatarsus is very curious. It does not occur in any known ungulate, and I am acquainted with no other mammal in which it can be found. A tarso-metatarsus, in the same sense, but to a less degree, as in birds, is thus formed.

The *Metatarsus* is very long, and of about the same proportions as in the moose.

The *Phalanges* of the median digits are a little longer than in the fore-foot, those of the rudimentary digits of about the same size.

#### CONCLUSION.

*Cervulus Americanus* is a very interesting form, and offers some morphological suggestions of great value. Geologically it teaches little that was not known. Its occurrence so far south of the moose's range, points to a colder climate than the present,

though the perfect preservation and freshness of the bones in the Princeton skeleton make it hard to believe that they are more than a few years old.

In all probability the habits of the animal, and to a great degree its appearance, were those of the moose. Its short neck shows that it would have great difficulty in grazing, and so probably lived by browsing upon shrubs and trees. This was aided, no doubt, by a more or less prehensile upper lip, which the character of the nasal opening shows to have been more proboscis-like than in the deer, though far less so than in the moose.

Morphologically the fossil is of interest for the light which it seems to throw upon the question of the origin of the genus *Alces*, and its relations to the typical deer. Sir Victor Brooke and Prof. Garrod have shown that the *Cervidæ* may be subdivided into great groups according to the characters of the skull and fore-feet. According to the latter we have the Plesio- and Telemetacarpi, or those which retain the proximal and distal ends of the metacarpals respectively. With one exception, *Cervus canadensis*, all American deer are Telemetacarpi, while nearly all of the Old World deer are Plesiometacarpi. Those of circumpolar range, the reindeer and moose, are both Telemetacarpi. Another distinction is found in the structure of the skull. In one division, the American deer (except *C. canadensis*), the vomer reaches the palatines and projects beyond them, dividing the posterior nares into two. The Old World deer have a vomer that does not reach the palatines, and the posterior nares are not divided. In *Alces* we have the latter type of skull.

The chief differences between the true *Cervus* and *Alces* are as follows: (1) The former is plesio-, the latter tele-metacarpal, both agreeing in the structure of the nasal passages. (2) *Cervus* has cylindrical antlers, with brow- and bez-tines rising abruptly from long pedicels. *Alces* has palmated antlers, without brow- or bez-tines, the beam directed horizontally from the short pedicels. (3) In *Alces* the nasals are very short, the anterior nares of great extent; in *Cervus* the nasals are long, and the anterior nares small. (4) In *Alces* the premaxillæ are imbedded in a groove of the maxillæ, and do not reach the nasals; in *Cervus* they lie external to the maxillæ, and (in some species at least) do reach the nasal. (5) In *Alces* there is a deep notch on the supra-

occipital, and a prominent knob on the frontal ridge, neither of which is present in *Cervus*. (6) In *Cervus* the skull is short and broad, and the diastema of moderate length; in *Alces* the skull is long and narrow, and the diastema very long. (7) In *Cervus* the tympanic bulla is inflated; in *Alces* not. (8) *Cervus* has a horizontal zygoma; in *Alces* it is directed downwards and forwards. (9) *Cervus* possesses canine teeth in both sexes; *Alces* in neither. (10) *Alces* has a short neck and trunk, long limbs and head; *Cervus* has longer neck and trunk and shorter legs. (11) In *Alces* there is a proboscis-like upper lip and almost obsolete rhinarium; *Cervus* has larger rhinarium and ordinary snout. In nearly all of these particulars, *Alces* is plainly a greater departure from the ordinary cervine type than is *Cervus*, and must, therefore, be regarded as a more differentiated and highly specialized form. If this be the case, we should naturally conclude that *Alces* is the descendant of some form much more closely allied to *Cervus* than itself is. That the descent cannot be from the actual genus *Cervus* seems to be plain from the character of the fore-foot. A reasonable inference seems to be that the common ancestor of the two genera had already attained the structure of skull found in the Old World deer, but that its fore-feet were tetradactyl, the lateral metacarpals, though slender, were complete or nearly so in length.

Now *Cervalces* throws some light upon this community of origin and subsequent divergence of the two genera. In many respects, as we have already seen, *Cervalces* differs very decidedly from *Alces*, and nearly all these differences are approximations to the structure of *Cervus*, a result which can hardly be accidental. But except in the skull, the structure of the fossil form is much nearer to that of *Alces*. The fossil agrees with *Alces*: (1) In the short neck and trunk and very long legs; (2) in being telemetacarpal; (3) in having palmated antlers; (4) in the absence of an inflated tympanic bulla; (5) in the shape of the zygoma; (6) in the absence of canine teeth.

On the other hand it agrees with *Cervus*: (1) In the presence of the bez-tine (?) and posterior tine on the antlers; (2) in having long nasals; (3) in the shape and relations of the premaxillæ; (4) in the absence of the supra-occipital notch and knob on the frontal ridge; (5) in the greater proportionate breadth of the

skull; (6) *Cervalces* almost certainly had a rhinarium and upper lip more like that of *Cervus* than of *Alces*.

*Cervalces* differs from both genera: (1) In the intermediate condition of the anterior nares; (2) the peculiar antlers; (3) the distinct prefrontals; (4) the remarkable concentration of the tarsals.

It thus seems very probable that *Alces* is descended from a type with limbs, skull and antlers of the ordinary type and with tetradactyle fore-feet, but has modified these in various ways. The length of limb seems to be connected with the habitat of the animal in snowy regions, and we are told that the moose can make his way with great swiftness through snow-drifts that will engulf ordinary cattle. The unusual size of the lateral digits seems to have reference to the animal's habit of living in swampy lands during the summer, and so needing a broad surface to prevent sinking in the mud. The shortening of the neck is difficult to account for, but the proboscis-like upper lip seems to be clearly connected with the habit of browsing upon trees. Shortening of the neck is very generally associated with the development of a prehensile lip; *e. g.*, the combined length of head and neck in the rhinoceros is relatively greater than in the tapir.

*Cervalces* seems to have been a contemporary of the moose which also occurs in quaternary deposits, though in all probability the former is the older of the two. Its extinction may be referred to the general causes which destroyed so many of the large quaternary mammals, though the competition of the more perfectly adapted moose may have had something to do with it.

Whatever taxonomic value be allowed to the peculiarities of this strange fossil, the fact remains that in it we can catch some glimpse of the successive steps by which the remarkable genus *Alces* has originated.

*Measurements.*

	<i>Alces.</i>	<i>Cervalces.</i>	<i>Megaceros.</i>
	M.	M.	M.
Length of trunk from 1st rib to end of ischium, . . . . .	1·478	1·550	1·683
Length of thorax, . . . . .	·703	·755	·840
Length of lumbar region, . . . . .	·440	·435	·444
Length of sacrum, . . . . .	·235	·225	·241
Length of neck, . . . . .	·515	·563	·756
Length of skull, . . . . .	·550	·586	·453
Breadth of forehead, . . . . .	·205	·255	·220
Distance between burrs of antlers, . . . . .	·165	·234	·120
Length of nasals, . . . . .	·103	·181	·170
Anterior nares from nasals to tip of premax. . . . .	·285	·185	·120
Span of antlers, . . . . .	1·175	1·620	2·260
Length of antler, measured along outside curve, . . . . .	·925	·863	1·702
Length of pedicels, . . . . .	·020	·028	·048
Greatest height at withers, . . . . .	1·695	1·810	1·890
Height at sacrum, . . . . .	1·565	1·680	1·610
Height at occiput, . . . . .	1·610	1·790	1·940
Height at tip of antler, . . . . .	2·253	2·342	2·740
Length of fore-leg (straight line), . . . . .	1·565	1·685	1·620
Length of scapula, . . . . .	·443	·443	·455
Length of humerus (fr. tuberosity), . . . . .	·405	·425	·375
Length of radius, . . . . .	·415	·450	·378
Length of carpus, . . . . .	·043	·055	·045
Length of metacarpus (outside), . . . . .	·318	·355	·324
Length of phalanges, . . . . .	·193	·225	·188
Circumference of humerus, (below exter. tuber.), . . . . .	·175	·185	·200
Circumference of radius, . . . . .	·132	·140	·145
Circumference of metacarpus, . . . . .	·118	·132	·135
Length of hind-leg (straight line), . . . . .	1·450	1·477	1·360
Length of femur (from head) . . . . .	·435	·440	·435
Length of tibia, . . . . .	·485	·512	·450
Length of tarsus, . . . . .	·097	·117	·114
Length of metatarsus, . . . . .	·385	·421	·343
Length of phalanges, . . . . .	·213	·234	·197
Circumference of femur, . . . . .	·147	·155	·180
Circumference of tibia, . . . . .	·175	·170	·190
Circumference of metatarsus, . . . . .	·135	·147	·150
Longest dorsal spine, . . . . .	·283 (3d)	·290 (3d)	·367 (8th)
Circumference 4th cerv. vertebra, . . . . .	·340	·373	·490
Circumference of last lumbar (incl. spine), . . . . .	·290	·295	·375
Length of pelvis, . . . . .	·501	·490	·520
Longest rib (from tubercle), . . . . .	·533 (8th)	·550 (8th)	·610 (9th)

It will be noticed that the dimensions here given for *Megaceros*, which are taken from a skeleton in the Princeton Museum, are very different from those given by Owen in his "British Fossil Mammals." The discrepancy is largely due to different methods of mounting.

## EXPLANATION OF FIGURES AND PLATE.

FIG. 1. Side view of skull of *Cervus canadensis*.

FIG. 2. Side view of *Cervalces americanus*.

FIG. 3. Side view of *Alces machlis*.

References for figs. 1-3.—*Fr.*, frontal; *N.*, nasal; *Tb.*, turbinal; *Pmx.*, premaxilla; *M.*, maxilla; *Pf.*, prefrontal (?); *O.*, orbit; *A. O.*, ante-orbital vacuity.

FIG. 4. Skull and antlers of *Megaceros hibernicus*.

FIG. 4a. Right antler of *Megaceros hibernicus*, from the inside (from Owen, British Foss. Mam. and Birds, fig. 186, p. 456).

FIG. 5. Skull and antlers of *Cervalces americanus*.

FIG. 6. Skull and antlers of *Alces machlis*.

References for figs. 4-6.—*Br.*, brow antlers; *Bz.*, bez-tine; *P. T.*, posterior tine (as of Brooke's system); *A.*, anterior division of main antler; *P.*, posterior division of main antler.

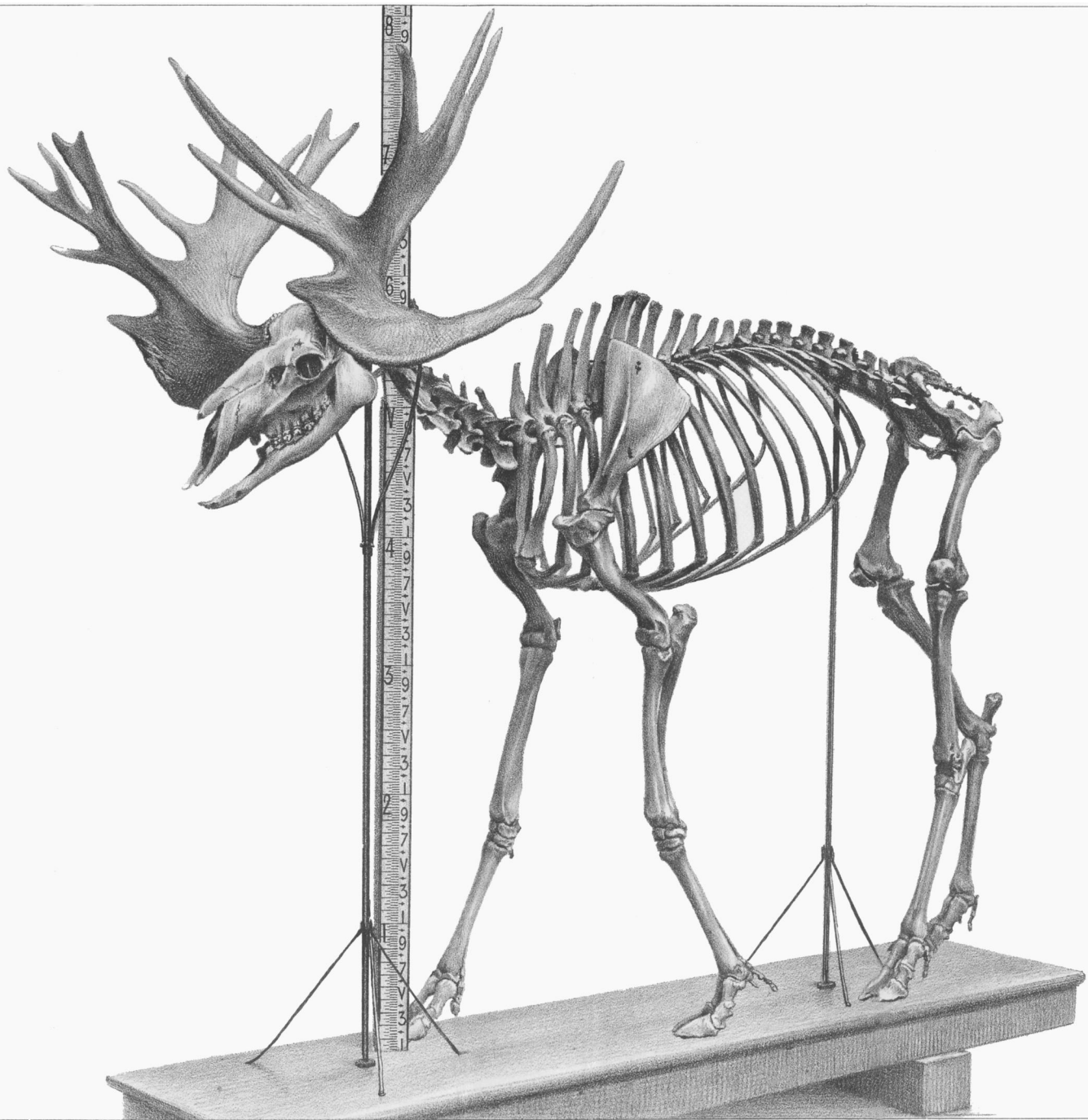
FIG. 7. Right tarsus of *Cervalces americanus*. *T.*, tibia; *Ca.*, calcaneum; *As.*, astragalus; *N. Cb. & C 2 & 3*, compound bone formed by fusion of cuboid, navicular, second and third cuneiforms; *C1*, first cuneiform, fused with metatarsus; *Mt.*, metatarsus.

## PLATE II.

Skeleton of *Cervalces americanus* (from a photograph). The scale is in feet, and tenths of feet.

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I wish to express here my obligations to Dr. F. C. Hill, Curator of the Museum, for his invaluable assistance in this work. I am indebted to him for the drawings of Figs. 1, 2, 3 and 7.



Lith. Werner & Winter, Frankfurt a. M.

CERVALCES AMERICANUS.